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Title: Introduction to Gamma Spec

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Intended for: Training for Emergency responders - including international partners

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Introduction to Gamma Spec

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Why

Determine radiation energy levels

to

Determine materials involved

Why we care
and
what we care about

- Materials
- Intervening materials

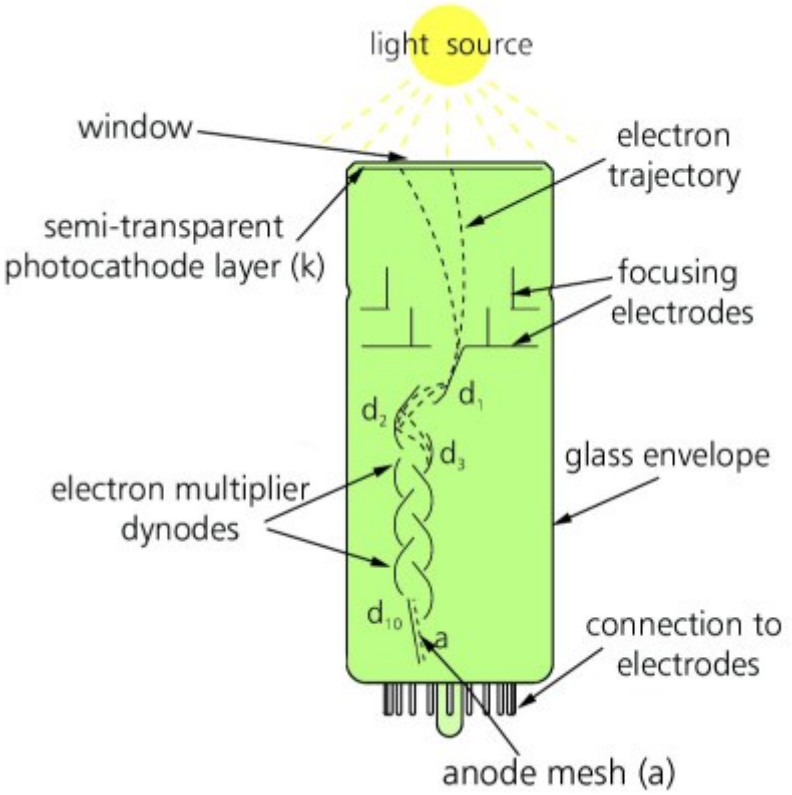
How

- Radioactive decay results in discreet energy transformations that uniquely identify the materials involved
- Alpha, Beta, Gamma
- Energy is absorbed by detector, transformed to electrical signal, amplified, “binned”, and displayed, stored, etc.

What and How
Scintillators

- NaI Sodium Iodide
  - Some radiation absorbed by NaI, excites it, decays by photon emissions (wavelength, time)
  - Interacts with PMT (Photomultiplier tube)
    - Photocathode converts light to electrons
    - Multiplies 10^6-10^7 to form a useable pulse
- CsI Cesium Iodide

PMTs


light source
window
electron trajectory
semi-transparent photocathode layer (k)
focusing electrodes
d_2
d_1
d_3
glass envelope
electron multiplier dynodes
d_{10}
a
connection to electrodes
anode mesh (a)

What
Solid State Devices

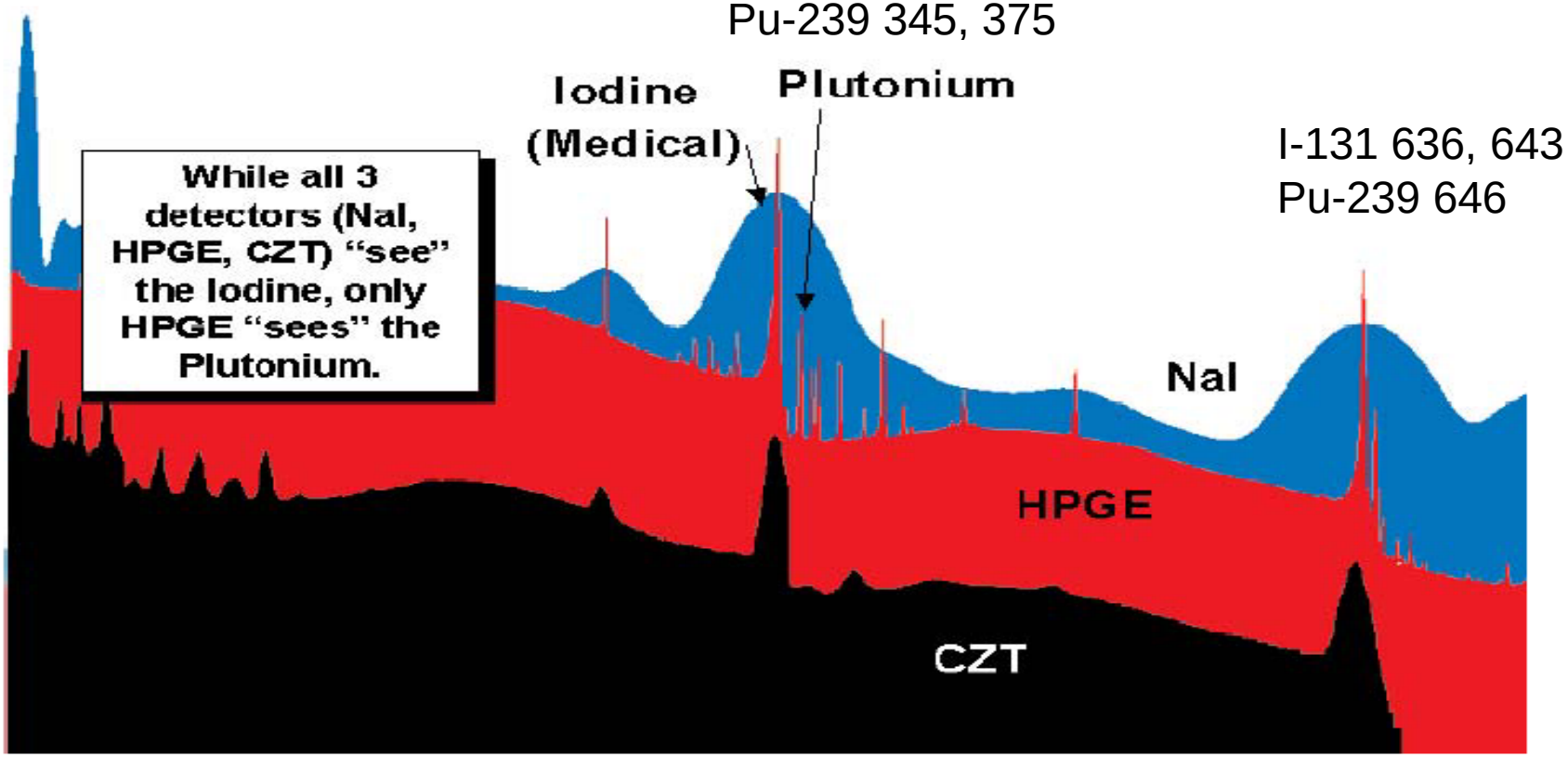
- CZT Cadmium Zinc Telluride
  - Room Temp
  - Small Crystal
    - Not efficient at high energies
- HPGe High Purity Germanium
  - Cooled to LN_2 temperatures (-245° F)
    - Crystal
    - Pre-amp
  - Size does count – relative to 3”x3” NaI

What and How
Solid State Detectors

- Radiation reacts in crystal, creates ion pairs, ions swept through crystal and collected on anode and cathode
- Multiplied and collected for display, processing, etc.
- Better resolution
  - Faster
  - No translation, transmission, etc.

Comparison

I-131 364
Pu-239 345, 375



I-131 636, 643
Pu-239 646

Figure 2. HPGe in comparison to NaI and CZT detectors.

http://www.ortec-online.com/papers/detective_paper.pdf

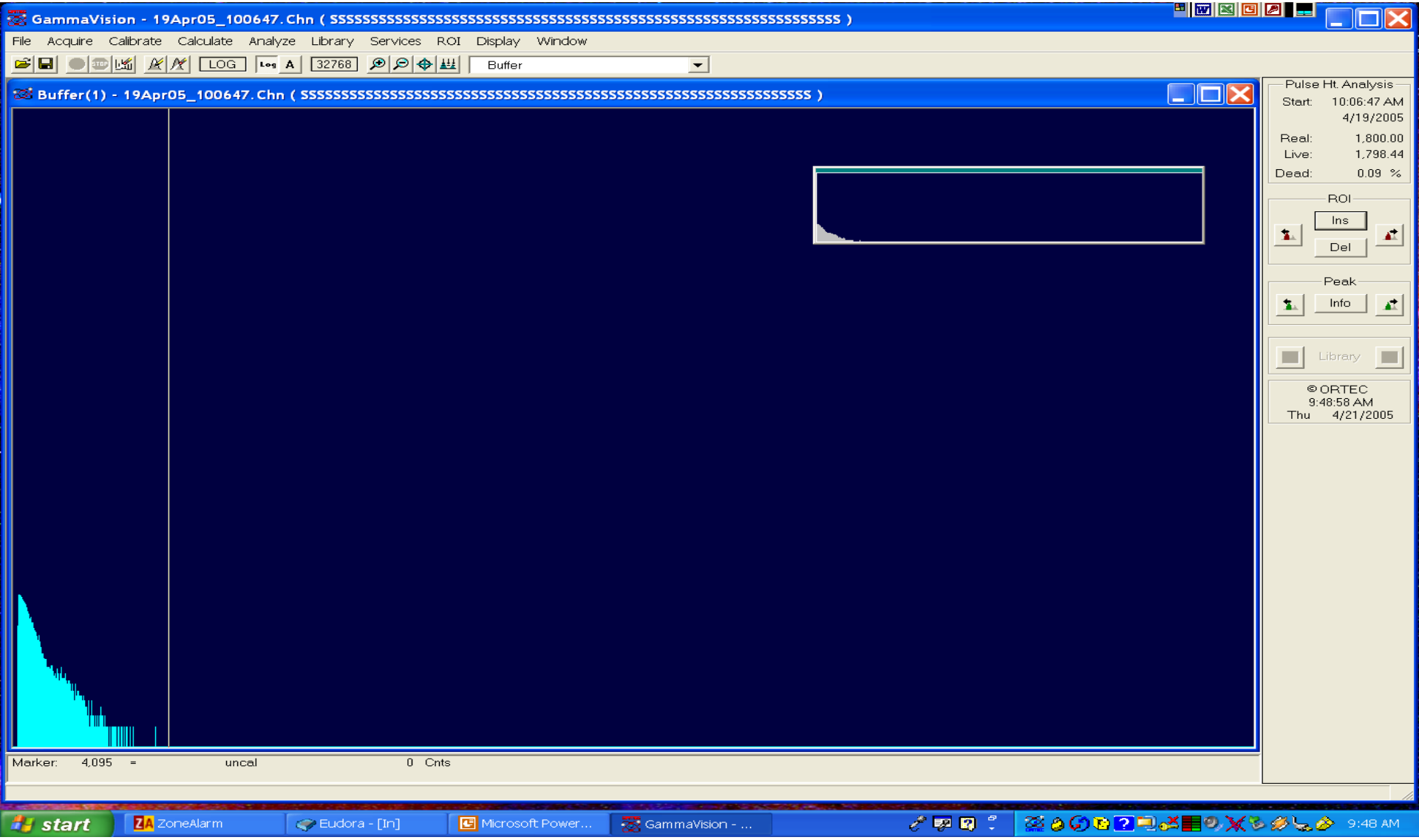
Issues

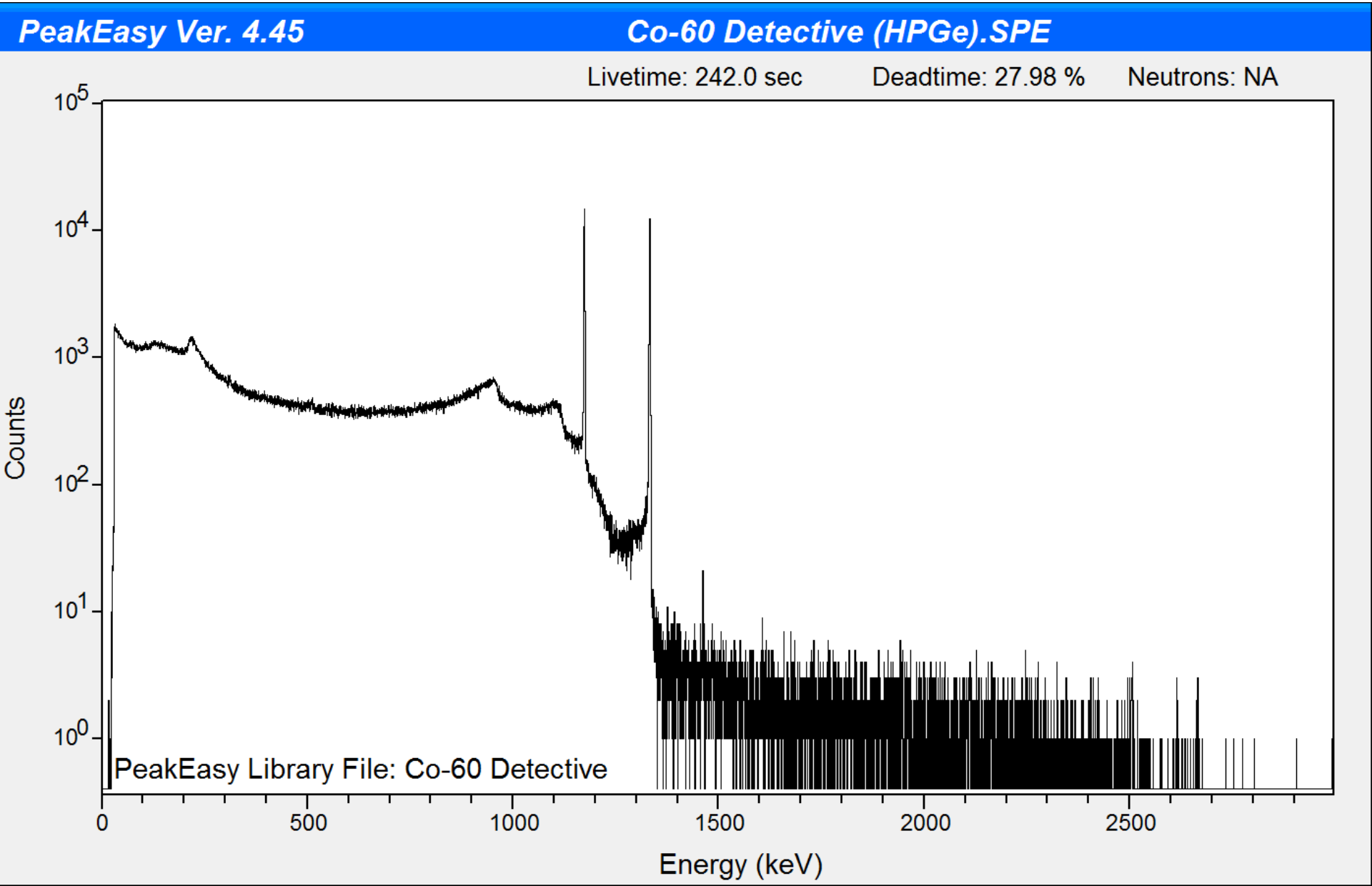
- Drift
- Progeny
- Shielding
- Other (radioactive) materials

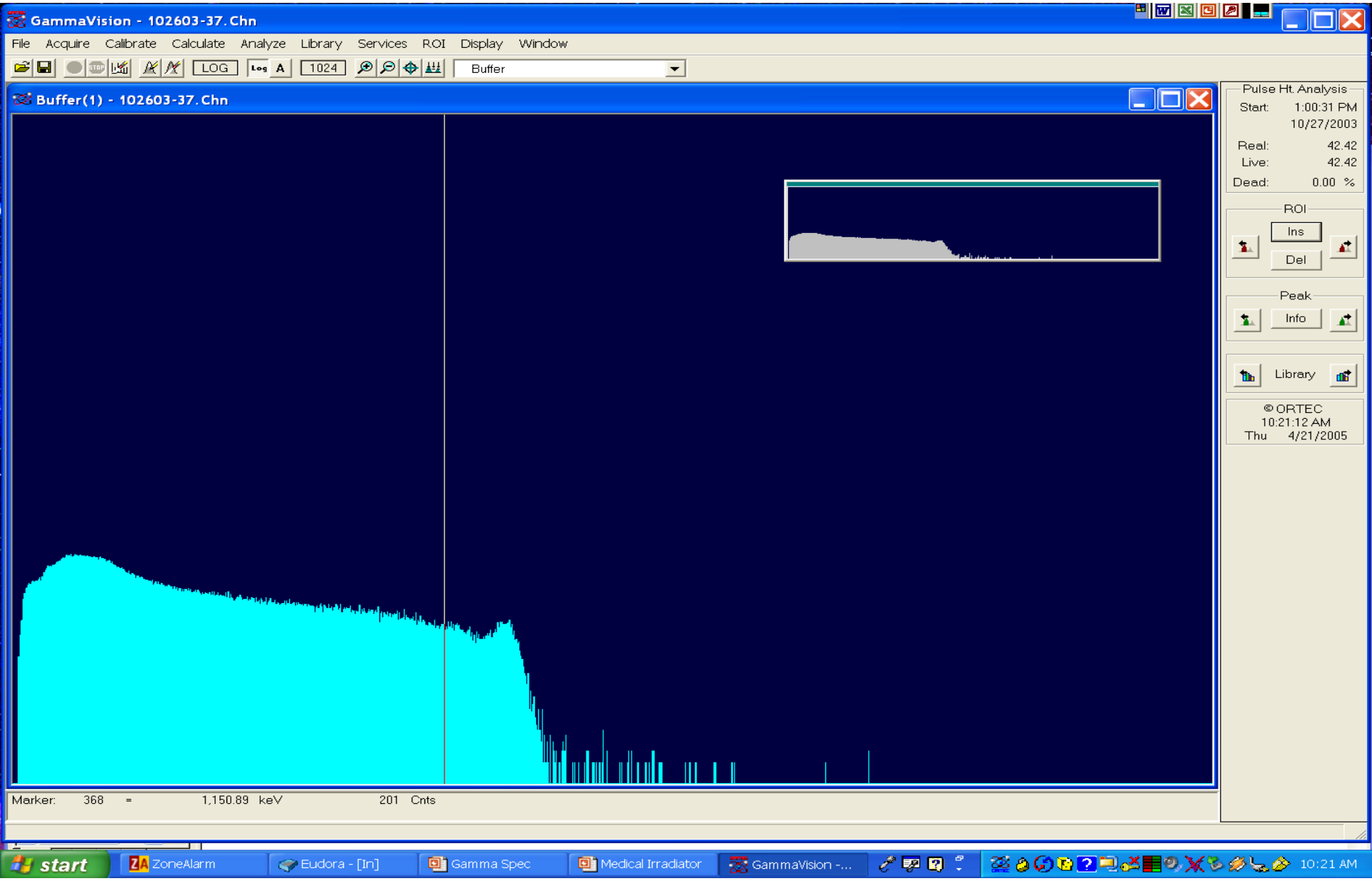
ID’ing

- Calibration
- Lines
- Abundances
- Progeny
- Interferences
  - RF
  - Magnetics
  - Background
    - Fluctuates, varies

Spectra


GammaVision - 19Apr05_100647.Chn (SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS)
File Acquire Calibrate Calculate Analyze Library Services ROI Display Window
LOG
32768
Buffer
Buffer(1) - 19Apr05_100647.Chn (SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS)
Pulse Ht. Analysis
Start: 10:06:47 AM
4/19/2005
Real: 1,800.00
Live: 1,798.44
Dead: 0.09 %
ROI
Ins
Del
Peak
Info
Library
© ORTEC
9:48:58 AM
Thu 4/21/2005
Marker: 4,095 = uncal 0 Cnts
start
ZoneAlarm
Eudora - [In]
Microsoft Power...
GammaVision - ...
9:48 AM


PeakEasy Ver. 4.45
Co-60 Detective (HPGe).SPE
Livetime: 242.0 sec
Deadtime: 27.98 %
Neutrons: NA
Counts
10^5
10^4
10^3
10^2
10^1
10^0
PeakEasy Library File: Co-60 Detective
0
500
1000
1500
2000
2500
Energy (keV)


GammaVision - 102603-37.Chn
File Acquire Calibrate Calculate Analyze Library Services ROI Display Window
LOG
1024
Buffer
Buffer(1) - 102603-37.Chn
Pulse Ht. Analysis
Start: 1:00:31 PM
10/27/2003
Real: 42.42
Live: 42.42
Dead: 0.00 %
ROI
Ins
Del
Peak
Info
Library
© ORTEC
10:21:12 AM
Thu 4/21/2005
Marker: 368 = 1,150.89 keV 201 Cnts
start
ZoneAlarm
Eudora - [In]
Gamma Spec
Medical Irradiator
GammaVision -...
10:21 AM

Medical Irradiator

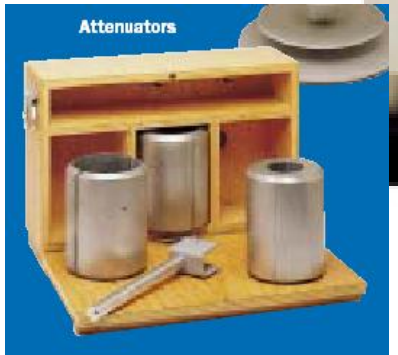
Shipped from Canada to hospital in Boston. RIID gives incorrect identification.

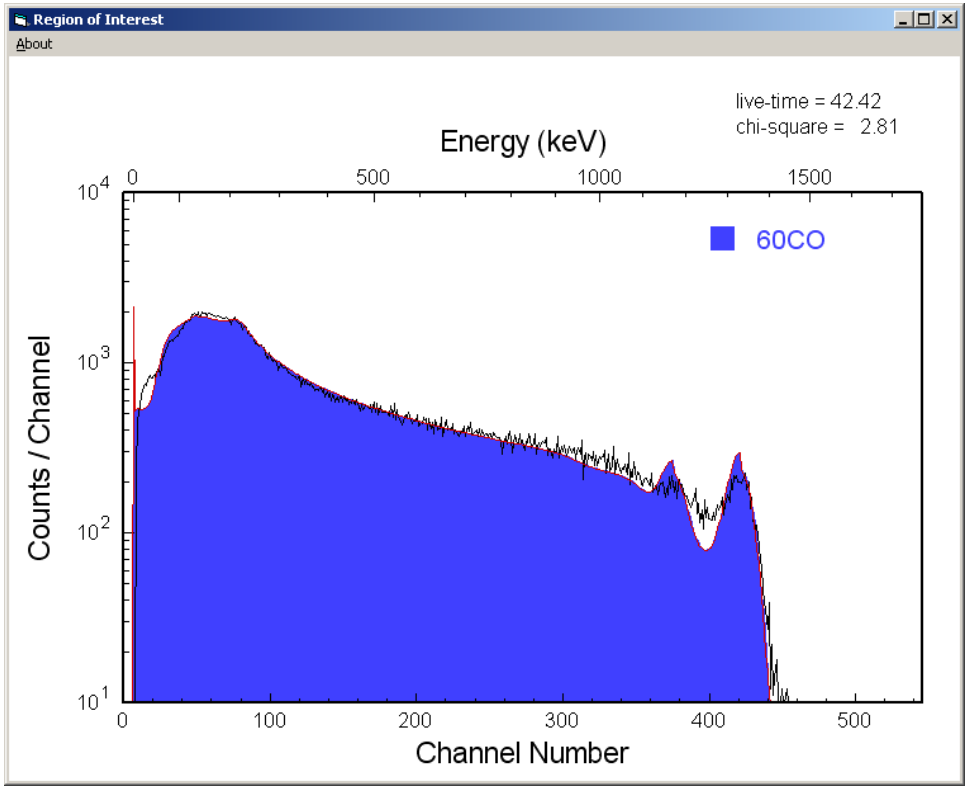
24 kCi Co-60, heavily shielded.

Used for medical sterilization, blood & bone for transplants, research applications.

MDS™ Nordion™†
Science Advancing Health

Gammacell®
220 Excel





Spectrum consistent with heavily shielded Co-60. The 1173 keV peak is not visible.

Radiation from wooden box with collimators was just scatter.